First of a Series on

WHALES—MONSTERS OF THE DEEP

THE OCEAN HOME OF WHALES

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 376

March 4, 1961

The Ocean, Home of Whales

These stories are about whales, the largest animals that have ever lived.

It helps sometimes when you are curious about an animal to know something about where it lives and how it lives. Whales live in the ocean. They can't come out on land at all.

Let's find out a little about the ocean. And only a little is what we can find because the ocean is still the great unexplored area of our earth. We know the surface of the ocean, the tides, the currents, and the action of winds, for man has used the ocean for travel for hundreds of years and even in prehistoric times people journeyed over the water in boats. We also know something of the animals that live near the surface of the ocean and in the waters near the shores.

But the deep parts of the ocean are still a mystery. Diving equipment is being developed that in future years will enable man to study the floor of the deepest ocean and the creatures that live there. There are many problems to be solved before we can explore the ocean depths—almost as many as there are before we can explore the space beyond our earth.

Our explorations lead us to believe that it was in the ocean that life began. The simplest forms of life are in the ocean. These simple forms are called *plankton,* a word that means "that which is made to wander or drift." The tiny living particles do drift, unable to stop if they wanted to.

For a long time the true nature of plankton was unknown. With better equipment it was found that plankton actually is made up of tiny plants and animals, some so small that you need a microscope to see them. Scientists talk about *diatoms* and *phytoplankton,* meaning plant plankton, and *zooplankton,* meaning animal plankton.

The chain of life in the ocean has many links, as does life on land. Animals must have plants to eat. Ocean plants manufacture food by the process of photosynthesis, as do land plants. All plants must have water, minerals, chlorophyll, and sunlight to manufacture food.

Chlorophyll is in every green plant. Of water there is plenty in the ocean. Sunlight strong enough to be of use to plants penetrates only about eighty feet below the surface of the ocean. Plants cannot grow below that depth.

Necessary minerals are abundant in the ocean, and the supply is constantly being renewed. Water falling on land as rain runs off through streams and rivers and eventually reaches the ocean, carrying with it many minerals (some of which sink to the ocean floor). Minerals in animal bodies are returned to the ocean when death and decay occur. But since ocean water is constantly moving because of currents, winds, turbulence, and "welling up," the bottom layers of mineral-rich water are constantly replacing surface water so that ocean plants seldom lack needed raw materials.

Planktonic animals and those only slightly larger, such as shrimps called krill, eat planktonic plants to obtain the carbohydrates, proteins, fats, minerals, and vitamins that they need. In turn, more complicated animals eat these tiny animals, and so the chain of life continues, even in the ocean. It may seem strange to you, but the largest animal ever known, the great blue whale, feeds on some of the smallest living things—plankton and krill.

plankton greatly magnified

This page is for your own notes and illustrations

Second of a Series on

WHALES—MONSTERS OF THE DEEP

WHALES
MAMMALS OF THE WATER

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 377

March 11, 1961

Whales—Mammals of the Water

Naturalists consider whales to be among the most highly specialized of all mammals, living or extinct. Whales look so much like fish that they were not recognized as mammals until about three hundred years ago.

We know that all mammals have lungs to breathe air, have hair on their bodies, are warm-blooded, are born alive, and feed their young with milk from the mother's body.

Whales fit the description of mammals perfectly. Even though they live entirely in the water and never come out on land, whales must come to the surface of the water occasionally to blow stale air out of their lungs and breathe in fresh air. Records show that one of the largest of all whales, the sperm whale, can stay under water about forty-five minutes. We must remember, however, that whales have a great quantity of blood in proportion to their size for carrying oxygen to tissues during deep dives. The dark red of whale muscles leads one to think that more oxygen can be stored in these tissues than in the muscles of other mammals.

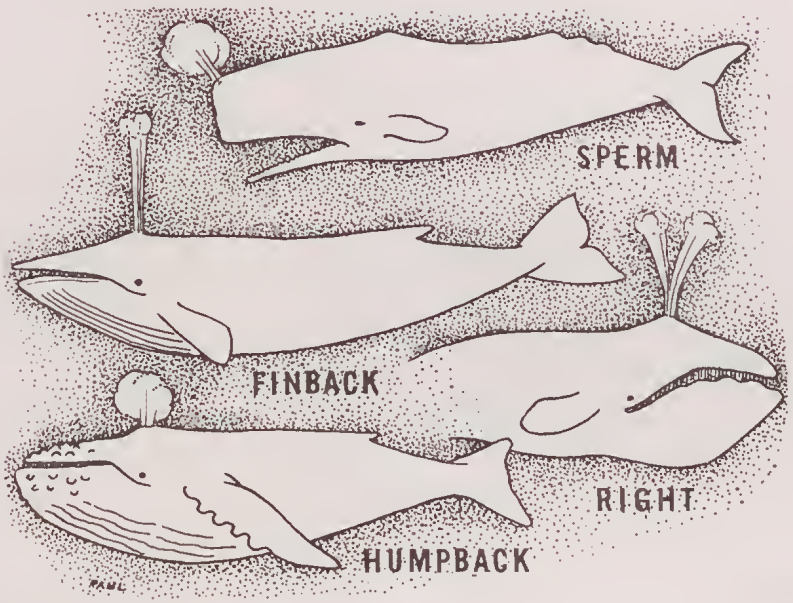
The whale's nostrils are called blowholes by whale hunters. Some whales have two nostrils and some have only one. Instead of being on the tip of the snout, where one would expect openings to be, they are on the top of the whale's head (except in the sperm whale) and connect directly with the lungs. This opening is equipped with a "lid" that can close tightly when the whale dives. No part of the whale's breathing apparatus opens into the mouth, and so the animal can swallow food under water without taking water into its lungs.

Experienced whale-hunters can recognize each kind of whale by the shape and height of the spout (vapor fountain) caused by the hot stale air striking the cooler atmosphere when the whale exhales with a great gust. The finback whale blows a thin high column of vapor, the great blue whale has a tall thick spout, and the humpback blows a low rounded cloud. The right whale's spout divides at the top, and the sperm whale shoots a low bushy puff forward and up.

Probably the most wonderful adaptation of whales is their ability to dive deep—two-thirds of a mile or more, or forty-six times the height of the main hall of this Museum. To go less than half this distance man must use special diving equipment, dive very slowly, and return to the surface even more slowly to avoid great suffering or death.

When a whale dives, it holds its breath and receives no additional air into its lungs. When a man dives, he has air containing fresh supplies of nitrogen mixed with oxygen and other gases of air pumped to him. Nitrogen bubbles form in the human blood-stream causing caissons disease if the human diver is brought too quickly to the surface.

Another big mystery is how whales can withstand the pressures of deep dives. At a half-mile depth there would be pressures of half a ton on every inch of body-surface. Man has developed diving equipment that allows dives of two and one-half miles. But how can the whale with no protecting equipment withstand the pressures when it goes to great depths to seek squids, cuttlefish, and octopuses to feed on!



This page is for your own notes and illustrations

Third of a Series on

WHALES—MONSTERS OF THE DEEP

WHALES ARE ADAPTED TO LIVING IN WATER

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 378

March 18, 1961

Whales Are Adapted to Living in Water

It is not clear just where whales fit in the sequence of classification of mammals. They are highly specialized for the life they live, and they are not closely related to any other mammals living today.

The oldest fossil remains of what can be recognized as ancestral whales indicate that even in the Middle Eocene epoch (about 50 million years ago) whales had much the same appearance as in modern times. Some were quite big even then and measured as much as fifty feet in length.

Those early whales (judging from fossils that have been found) had teeth in both jaws as do some living whales. Teeth were more differentiated in fossil whales than they are in modern whales but not as clearly differentiated as teeth of land-bound present-day mammals. The horse, for instance, has flat grinding molars in the back of its jaw and cutting incisors in the front.

Modern sperm whales, with few exceptions, have lost their upper teeth. Their remaining lower ones are alike—degenerate cone-shaped teeth that are good only for catching and crushing prey. There were about sixteen teeth in each jaw of early whales, but there are more than twice that number in the lower jaw alone of the sperm whale as we know it.

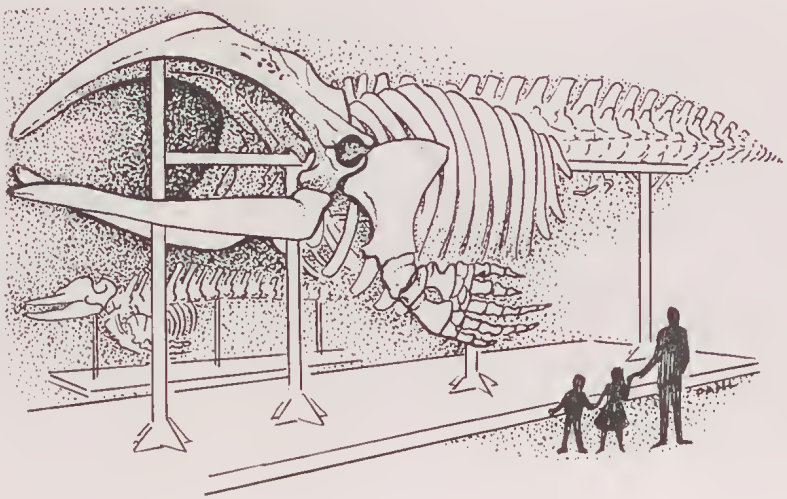
Superficially whales resemble fish more than any other mammal does. You do not notice a distinct separation in many whales between head and body where the neck would be. The whale's front legs, which to the casual glance do not resemble feet and legs at all, are swimming flippers used to steer and balance the whale in water, and you can see nothing at all of hind legs and feet. To swim, the whale uses the horizontal fin (fluke) at the end of its tail. It moves the fluke up and down diagonally, with a somewhat spiral motion, to propel itself through the water.

You can't see ears on the head of a whale, like the "shell" of your own ears. Whales do have a keen sense of hearing, however. Sound is conducted better through water than

through atmosphere, and so whales, even though their ears have no external shells, can hear very well. The only evidence you can see of ears is a tiny opening behind the eye no bigger than a lead pencil. The bones of the whale's ears are behind the lower jaw. For even so huge an animal, the ear bones are quite big and very hard—so hard, in fact, that they do not disintegrate as quickly as the whale's other bones and occasionally are brought to the surface by fishermen.

Whales, except Pacific gray whales, cannot turn their heads and must turn the whole body to see in various directions. The whale can see sidewise from its small eye on each side of its head, but not forward or back, and it is believed that whales do not see well in or above water.

If you examine the skeleton of a whale, like that of the right whale in the Museum, you will find that the tail fin is not a bony structure at all. You can see the tiny remains of pelvic (hip) bones that are not attached to any other part of the bony skeleton except by muscles. The bones of the skeleton are loosely connected so that the whale can turn and move very freely in the water. You can see that the whale, like most mammals, has seven vertebrae in the neck region, but the bones are compact and packed close together.



This page is for your own notes and illustrations

Fourth of a Series on

WHALES—MONSTERS OF THE DEEP

WHALES WITH TEETH

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 379

March 25, 1961

Whales with Teeth

There are two main groups of whales: those with teeth, called toothed whales, and those without teeth, called baleen or whalebone whales.

One of the largest whales (the great sperm whale) and the smallest whale (True's propoise) belong to the group with teeth. The great sperm whale grows to be seventy feet long and may weight one hundred tons. Its head may be about one-third of its entire length. Its twenty to forty cone-shaped teeth, which are alike, are not modified for certain jobs as your teeth are. These teeth are all in the long narrow lower jaw and mesh into sockets in the upper jaw (if there are any teeth in the sperm whale's upper jaw, they are small and useless). Sperm whales swallow their food (cuttlefish and squids mostly) whole and use teeth to catch their prey.

The sperm whale is the only whale whose blowhole is not on the top of its head. There is only one opening for breathing. It is on the left side of the head at the end of the snout. This opening is S-shaped, which causes the spout of the sperm whale to be low and bushy and to slant forward and up.

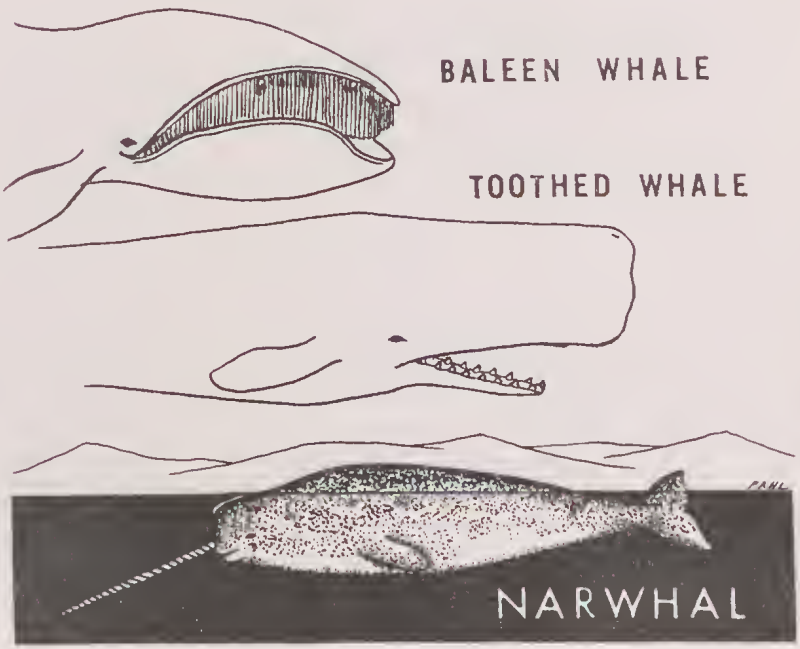
The other members of the toothed-whale group are much smaller than the sperm whale. The killer whale, which is sometimes called grampus, may grow to a length of thirty feet. Dolphins and porpoises are smaller still.

The killer whale is the most fearsome and has the largest appetite of all whales. Like the dolphins and porpoises, it has teeth in both jaws. Three or four killers will attack a giant blue whale, the largest of all whales, and usually the small whales are victorious. One sixteen-foot killer's stomach was found to contain parts of fourteen seals and thirteen porpoises, testifying to its huge appetite.

The killer's food is not limited to seals or porpoises. Fish of all sizes, young walruses, and even sea lions fall prey to a seemingly unlimited appetite. Nor do these carnivores confine their hunting to any one area. Killer whales can be found in all climates, wherever hunting is best.

You will never mistake a killer whale for any other, not only because killers travel in schools, or pods, of from three to forty individuals but also because of their dorsal fins, some as tall as six feet, which are sharp and shaped like a dagger. The fins continue to grow throughout the life of the killer and may be out of proportion to its body.

The oddest whale is in this group too. It is the narwhal. Narwhals live near the icebergs of the frozen Arctic instead of in open water. The strangest thing about this whale is its tusk. The narwhal has only two teeth, both in its upper jaw. One of the teeth develops into a spiral tusk nearly as long as the whale's body (the other tooth seldom shows outside the skull). This remarkable tusk tapers to a point, and only adult males have this tusk. Females and young ones seldom have any part of a tooth showing. In the Hall of Marine Mammals of this Museum you can see life-size models of narwhals, the animals that may have inspired the stories in ancient folklore about the mythical unicorn and its fabulous horn.



This page is for your own notes and illustrations

Fifth of a Series on

WHALES—MONSTERS OF THE DEEP

WHALES WITHOUT TEETH

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 380

April 8, 1961

Whales without Teeth

The other big group of whales besides the toothed whales is the baleen or whalebone group. The biggest animal that has ever lived belongs to the baleen group—the blue or sulphur-bottom whale. Norwegian whale-hunters gave the name to this whale because at a distance they thought it looked as if it had been dipped in bluing. Some of these whales have a yellowish film on the underparts, and this gave rise to the name sulphurbottom whale.

Yes, the biggest animal in the ocean feeds on the smallest things alive—plankton and krill. Wherever plankton is the most abundant, especially in seasons of heaviest "bloom," that is where you will find the baleen whales.

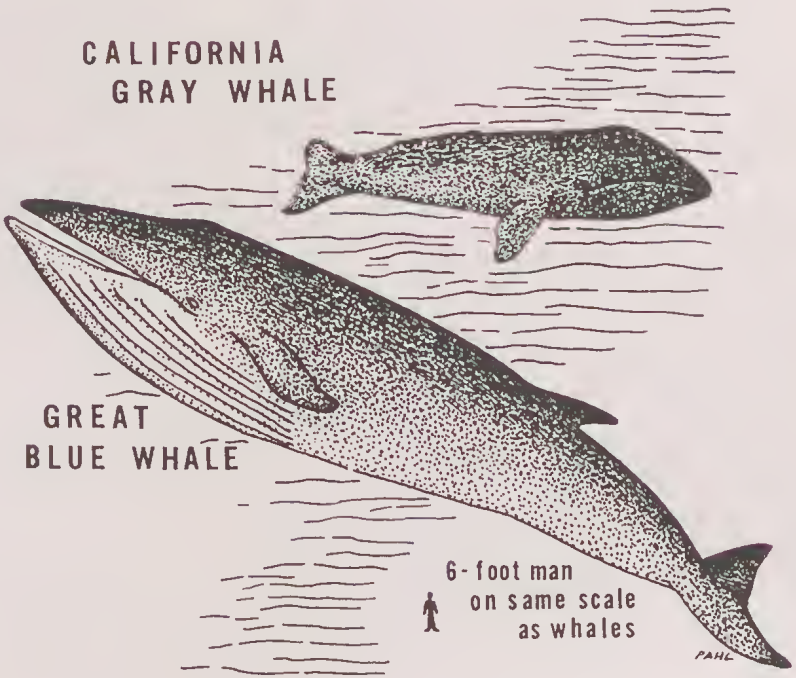
Before baleen whales are born they have traces of teeth in the upper jaw, but after birth these disappear. Although baleen is called whalebone it really is not bone but a skin growth. When you run your tongue across the roof of your mouth you feel ridges under the membrane covering your palate. Instead of these ridges, baleen whales have long flat plates of horny material called keratin (a substance much like your fingernails) that grow to lengths of eight to fourteen feet, although four feet is the average length. An edge of each plate (the edge near the tongue) is frayed into bristles of hairlike fineness and forms a thick mat.

To feed, the baleen whale swims along for awhile with its mouth open. Then it closes its lips and presses its flabby tongue against the baleen mat, pushing all the water out of its mouth. The mat of fibers allows the water to escape, but it keeps the plankton and krill and possibly a few small fishes inside the baleen trap. This mass of food is swallowed whole many gallons at a time. An average meal for a big blue whale might be a ton of plankton.

Baleen whales, except the California gray whale, are not strong fighters and make little effort to defend themselves when attacked. Mother baleen whales, however, will defend their little ones as best they can.

California gray whales earned the name "devilfish" because they are difficult to capture. They will frequently charge a boat of whale hunters even in very shallow water and can change course quickly for the attack. Gray whales go to the shallow water of California bays and lagoons to breed and, about a year later, to give birth to little ones. When they are trapped in small areas of shallow water, gray whales can be driven close to land, and then it is easy for whale hunters to kill the fierce "devilfish."

At the beginning of this century it was thought that gray whales had all been killed, but in 1937 it was found that there were still gray whales in the waters near Japan and Korea. Now that they are protected from hunters by law, gray whales have come back to our own Pacific coasts. In one year recently more than four thousand gray whales were counted going past a given point during winter migration from the Bering Sea to winter quarters in Southern California.



This page is for your own notes and illustrations

Sixth of a Series on

WHALES—MONSTERS OF THE DEEP

RIGHT WHALE VERSUS WRONG

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 381

April 15, 1961

Right Whale versus Wrong

The right whale, according to the Basque whale-hunters of about a thousand years ago, was the one that yielded the most oil to burn in their dip-wick lamps. To them the whale with the thickest blubber was the "right whale to kill."

The "wrong" whales were all the others they saw in the waters they sailed that would be as dangerous to kill but would not yield as much oil. The name "right" used in this manner has persisted to the present day, and three species of baleen whales are called right whales: black right whale, Greenland right whale, and pigmy right whale.

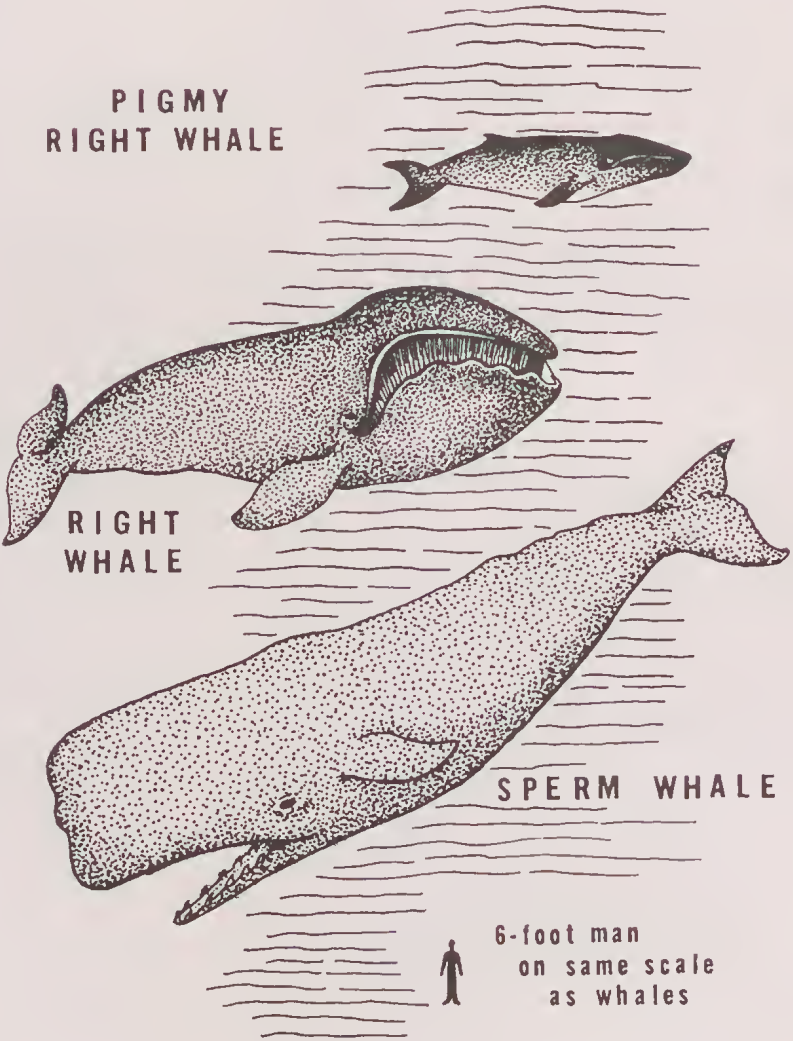
Another thing that distinguished the "right" whales from the "wrong" ones was the fact that the right whales would float after being killed. The others would sink, making it hard to get them to shore. If we could change the names of whales, the sperm whale today might be called the "right" one because of the great number of things we make from it.

For hundreds of years only baleen (whalebone) whales were hunted. The New England whale-hunters, starting about 1712, hunted the sperm whale because they found that this strange-looking monster, with its blunt rectangular head, had thick oil-rich blubber. In addition, the great cavity in the skull of the sperm whale was found to contain a fine oil in fluid state. As much as fifteen barrels of this high-grade oil could be dipped from its case, and more barrels could be had by boiling the granulated material, or spermaceti, that filled the remainder of the cavity.

The sperm whale produces ambergris, a waxy substance that resembles amber and floats on water. *Ambergris* means gray amber. Until recently ambergris only was used as a fixative for fragrance in the manufacture of expense perfumes, but less expensive chemicals now replace it. Ambergris itself has an unpleasant odor until it is heated.

Ambergris may be described as a wound excretion that accumulates in the intestines of sperm whales. These whales eat squids and cuttlefish, and if you look at the displays of these

creatures in the Hall of Invertebrates in the Museum you will see that the beaks are hard and horny and appear indigestible. As many as eighty beaks have been found in the stomach of one sperm whale! Imagine how irritating these sharp hard things were to the whale! Only sick whales produce ambergris. It was an unpleasant task to recover ambergris, but at one time it was worth twenty dollars an ounce. One ship collected seven hundred and fifty pounds of ambergris.



This page is for your own notes and illustrations

Seventh of a Series on

WHALES—MONSTERS OF THE DEEP

OCEAN TREASURE

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 382

April 22, 1961

Ocean Treasure

Your great-great-grandmother wore corsets stiffened with baleen (whalebone), and her collar was held high under her ears with the same light-weight material. Her perfume kept its fragrance because of ambergris. The frame of her umbrella was baleen. Your great-great-grandfather's buggy whip and the bill of his most stylish driving kepi (cap) were baleen.

The lamps in great-great-grandmother's house burned whale oil, and candles lighted for festive occasions were made of spermaceti. The axles of great-great-grandfather's wagon were lubricated with whale-oil grease.

Then petroleum oil was discovered underground in 1859, and kerosene, a by-product, replaced whale oil in lamps. Petroleum replaced whale oils and greases for lubricating machinery. Paraffin, a by-product in refining oil, was substituted for sperm-oil candles. It seemed that changing fashion and inventions would spell finish to the whaling industry.

Today, however, whaling is big business again. One-third the number of ships are needed to collect six times the amount of whale products that the New England whalers collected each year during the 1800's. New uses have been found for whale products and very little of the whale is returned to the ocean. Baleen, so much sought after in great-great-grandfather's day, is almost the only part discarded now. Plastics and steel have taken its place.

There are people in the world who do not have enough food, especially food high in protein. Modern refrigeration and other processing have made it possible to preserve whale meat for table use. Many expensive cosmetics have a spermaceti base: lipstick, face cream, suntan ointment, and even brushless shaving cream. The perfume industry still uses some ambergris in very expensive perfumes.

Many lubricants have a sperm-oil base, especially those for instruments demanding a fine high-grade oil, such as watches, electronic equipment, and electric typewriters. The hydraulic brake-system of the family car and hydraulic lifts operate

smoothly because of fluid with whale-oil base. Such things as printer's ink, typewriter ribbons, lead pencils, carbon paper, bottle caps, tanning solutions, and dressing for leather before it can be made into gloves, coats, luggage, and brief cases of high quality contain whale oil. Soap, detergents, and dressings for cloth contain whale oil.

Even the aluminum bases of electric-light bulbs require whale oil to keep the threaded part from "freezing" into the brass sockets of light fixtures. Fur coats are glossy because of whale-oil dressings. National defense needs glycerin, which is a whale product, for the manufacture of explosives. Farmers fertilize their fields and supplement the feed for their animals with products from the whale.

Many vitamins and life-saving medicines come from the whale. Insulin to treat diabetes, adrenalin for emergency illness and accident, thyroxin, A C T H, and petuitrin come from the glands of these ocean giants.

In spite of international agreement among whale hunters to limit the size and number of whales killed each year, the animals are rapidly disappearing from the oceans. In one year more than eighteen thousand sperm whales alone were killed. Although it is difficult to make a count of sperm whales (they feed in deep water), it is believed that they are being killed faster than they are multiplying. If more and cheaper substitutes for whale products could be discovered, whale hunting would then be less profitable and this would serve as a protection to the diminishing numbers of sperm whales.

This page is for your own notes and illustrations

Eighth of a Series on

WHALES—MONSTERS OF THE DEEP

WHALES IN THE PAST

by

MARYL ANDRE

Raymond Foundation

Museum Stories, No. 383

April 29, 1961

Whales in the Past

As early as the Late Stone Age, people of the islands and coast regions of northern Europe were hunting whales. Small whales (porpoises) could be driven to shore by hunters in skin boats using stone-pointed harpoons and inflated skin floats. We know that this is true because on the walls of shallow caves and on exposed slabs of rock pictures dating from prehistoric times have been found that show the hunt and the boats, whales, barbed darts, and keen-pointed lances.

Kitchen middens (trash heaps) of prehistoric people had skeletons of whales along with bones and shells of other food-animals, broken tools, and pottery. Prehistoric people must have had many uses for the whales that they caught or found stranded on the beaches. Ribs seem to have been used as frames of skin boats. Vertebrae were used for bowls on the islands off Scotland. One of the strangest tools found on the islands is of whale's bone in elongated pancake shape, with notches on one side and a hole for a handle at the end. In 1937 similar tools were being used by Eskimos in Greenland—adzes made especially to strip blubber from whales. Combs, mallets, knife handles, and even harpoons for whale hunting have been found that are made of whale's bones.

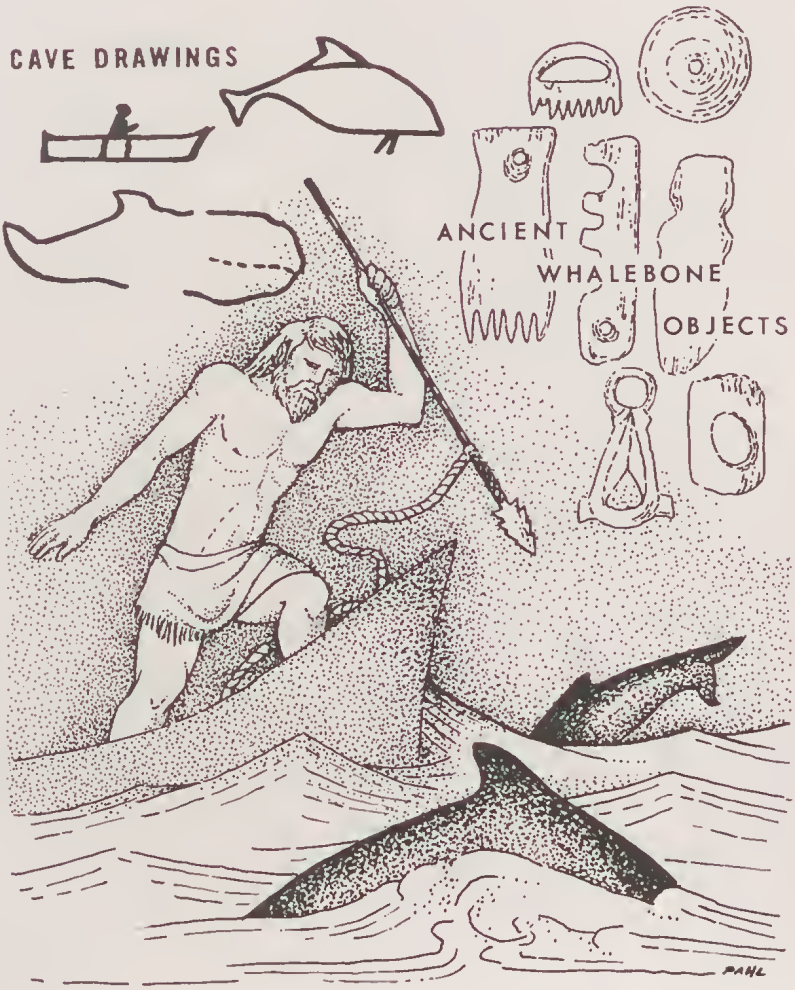
Whale meat was a regular item of food for people of Britain as recently as Henry VIII's time. Whale was allowed to be eaten on Friday and other fast days when fish usually was substituted for meat in religious homes.

The ancient Phoenicians and before them the people of Crete were leaders in shipping and trade with countries bordering the Mediterranean, and so they probably were leaders in whale hunting in those early times. Until recently some of the inhabitants of the southern shore of the Persian Gulf used whale ribs for rafters and jawbones for doorposts, as did their prehistoric ancestors, and today these people still carry on regular trade in whale's teeth.

So it has been down through the ages to modern whale ships and modern uses of whale products. Hunters of whales have

been the early explorers of the waters where whales were to be found. The search for new hunting grounds led to discovery of new lands and founding of new colonies.

Many important observations are reported by whale hunters aboard factory and catcher ships that are trapped sometimes for months in ice-bound waters. Now the "Great Adventure" is centered more and more on the mysteries at the bottom of the ocean. The more we can learn of the habits of whales, the closer we will be to solving some of the mysteries.



This page is for your own notes and illustrations